Appendix F

CHARACTERIZATION OF THE POTENTIAL IMPACT OF STORMWATER RUNOFF FROM TAMIAMI TRAIL ON THE NEIGHBORING WATERBODIES

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Introduction

This review provides a characterization of the potential impact of stormwater runoff from the subject project area of the Tamiami Trail on the neighboring water bodies. The first part of the report demonstrates a general background and a description of the problem. The present status of water quality standards is then discussed to identify the water quality criteria for the water bodies adjacent to Tamiami Trail. Based on literature review of the pollutant concentrations in stormwater runoff from highways, a description of the pollutants and their expected levels from the Trail is provided. Next, the methodology adopted for this study is presented and followed by discussion of the results and biological aspects. The report is then concluded by a summary of findings.

The study area for this investigation is the segment of Tamiami Trail / US 41 for an approximately 11 – mile segment beginning 1 mile west of Krome Avenue in western Miami Dade County, Florida. The Alternatives Analysis performed in the Engineering Appendix for the General Reevaluation Report provided an overall review of the reconstruction of Tamiami Trail with and without stormwater treatment systems including innovative treatment scenarios. The findings of the analysis indicated the inclusion of stormwater treatment systems resulted in both wetland impacts and increased construction costs, whereas innovative treatment systems reduced wetland impacts but significantly increased construction costs. Conversely, eliminating stormwater treatment facilities will substantially reduce wetland impacts to Everglades National Park (ENP) as well as the overall cost of the project. This paper provides scientific support to the decision makers on the necessity of constructing treatment facilities of storm water runoff.

Background

Florida's rapid growth and urbanization in the 1960's and 70's generated vast amounts of land clearing resulting in the creation of impervious surfaces. These activities resulted in increased flooding and water quality degradation. Stormwater runoff may contribute sediment, nutrients and heavy metals to these waters. There was a realization that some of our rivers and streams, lakes, wetlands, and estuaries were being damaged.

Recognition of these problems led to the adoption in 1982 of *Chapter 17-25* (now 62-25), of the *Florida Administration Code, Regulations of Stormwater Discharge*. This regulation's primary objective is to minimize the pollution of Florida waters from new stormwater discharges that are constructed after February 1, 1982. The vast number of new stormwater discharges resulting from rapid growth preceded the determination of individual discharge limitations. It was agreed a performance standard be established providing a minimum treatment level such that a stormwater system would remove at least 80% of the annual pollutant load.

Extensive studies prior to this time determined that the "first flush" of stormwater carried 90% of the pollutant load from a storm event. Treatment of the first one inch of rainfall would help ensure that the water quality impacts of stormwater runoff were minimized. It also corresponds with the fact that over 90% of all storm events produce an inch or less of rainfall in a year.

Extensive research through the 70's and early 80's attributes 80 to 95% of heavy metal contributions to our waters to be from highways and parking lots. These metals include lead, zinc, copper, cadmium, and chromium. Other contaminants associated with highways and parking lots include oils and grease. These pollutants in highway runoff originate from the operation of motor vehicles, direct atmospheric fallout and the degradation of roadway materials. The most abundant metals have been lead, zinc and copper, which account for over 90% of the dissolved heavy metals.

Present Status of Water Quality Standards

Surface water quality standards for the State of Florida are documented in *Chapter 62-302.500, Florida Administration Code, Surface Waters: Minimum Criteria, General Criteria*. These standards establish the criteria for water quality for the five classes of water, including special protection for Outstanding Florida Waters (OFW). The designation of OFW mandates that there will be no degradation of the ambient water quality within the area. The five classes include Class I - Potable Water Supplies, Class II - Shellfish Propagation, Class III - Recreation Waters, Class IV - Agriculture Water Supplies, and Class V - Navigation, Utility and Industrial Use. For each class of waters there is an established list of constituents for which a surface water criterion exists. Unless stated, all criteria express the maximum not to be exceeded at any time.

The Tamiami Trail is the boundary between two classes of waters. North of the Trail is considered Class III waters; whereas, the south side of the Trail falls within Everglades National Park and is considered Class III Outstanding Florida Waters.

Pollutant Concentrations in Stormwater Runoff from Highways

The concentration of pollutants in highway runoff is dependant on a number of factors including highway design, maintenance activity, surrounding land use, climate, and site specific traffic characteristics (Gupta et. al. 1981, Vol. I).

Highway stormwater runoff contains higher concentrations of trace metals, particularly lead and zinc, than the water samples from adjacent receiving water bodies (Yousef et al., 1986 and Harper, 1988). Soils adjacent to highways have higher concentrations of lead, chromium, and zinc than the background levels of these metals (Wanielista and Gennaro, 1977). Generally, lead, zinc, and copper are the major contributors to pollutant loading in highway runoff, with peak concentrations occurring within the first thirty minutes of rainfall.

Pollutant concentrations in stormwater runoff have been significantly reduced in the 1990's due to the stricter environmental regulations implemented to protect natural habitat and to enhance environmental conditions in rural/urban areas. One of the major milestones, in this regard, was the elimination of lead from gasoline and paint.

A recent study, conducted in 1996 by HDR Engineering, Inc. at the Howard Frankland Bridge (I-

275) in Tampa, Florida shows a substantial decrease in the average pollutant concentrations, of lead, zinc, iron, copper, and cadmium in water samples collected at the edge of pavement (to collect the samples just as it flowed off the impervious roadbed) than the average values detected by Gupta et. al 1981 in samples collected from seven locations in the eastern U.S. during 1967-77. In addition, the HDR study assessed the capability of the grassed shoulders to reduce contaminant levels in stormwater runoff from the highway. For most metals, documented treatment efficiencies ranged from 10 to 74%.

Stoker (1996) indicates similar decreases in the concentrations of lead, zinc, iron, cadmium, chromium, and copper in stormwater runoff samples from the Bayside Bridge in Pinellas County, Florida. Stoker's study shows improvements over those previously reported by Yousef et al., (1986) and Harper, (1988) for samples collected near I-4 in the Orlando area.

By comparing the metal contents in stormwater runoff from highways for the 1996 studies and 1980's studies, one can observe a decreasing trend in metal concentrations in the stormwater runoff over time.

Methodology

The methodology adopted in this analysis included a comparison of predicted pollutant concentrations from the Tamiami Trail to a) existing trace metal levels insitu and; b) Class III Fresh Water Criteria. Existing trace metal concentrations were obtained from South Florida Water Management District (SFWMD, 2000) for the study area (Northwestern limit: Lat. 25° 50`, Long. 80° 45` – Southeastern limit: Lat. 25° 40`, Long. 80° 20`) for the 1980's and 1990's. There are a total of ten sampling stations along Tamiami Trail, starting at Station S12D and ending with Station S334 (Figure 1). S12D is located at a spillway on levee L-29 in Conservation Area 3A; S333 is located at the Tamiami canal below S-333; S12E, G69, and S334 are located at gated culverts; S333DS is located downstream of S333 on US41 at the south side of the canal; FROGCITY is located at a culvert under US41 6.0 miles west of S334; S355A and S355B are Cape Sable seaside sparrow sampling locations; and TAMBR6 is located at a culvert under US41, 3.3 miles west of S334. SFWMD classifies these sampling locations as canal/ambient waters.

Class III Fresh Water Criteria for cadmium, chromium, copper, lead, nickel, and zinc were calculated according to the governing equations using the corresponding hardness values at each sampling station. Predicted contaminate levels were estimated using the data obtained from the Howard Frankland Bridge (I-275), Tampa, Florida and the Bayside Bridge, Pinellas County, Florida, as these projects represent the most recent studies, similar climate conditions, and geographical locations.

Tamiami Trail traffic counts recorded approximately 5,200 vehicles per day (VPD) in 2000, and are projected to reach 9,200 (VPD) in 2020 according to the Florida Department of Transportation. Drapper et. al. (2000) reported correlation of median pollutant concentrations (lead and total suspended solids) in stormwater runoff from highways to the Average Daily Traffic. This approach was utilized to predict pollutants levels in Tamiami Trail stormwater runoff for the estimated traffic volumes (Tables 1, 2, and 3).

Based on the data recorded for the I-275 study, predicted levels of cadmium, chromium, copper, iron, lead, manganese, nickel, oil and grease, total solids, total suspended solids, and zinc for the Tamiami Trail are listed in Table 1. The Pinellas County study includes the analysis of these contaminates with the exception of manganese, oil and grease, and total solids. Predicted concentrations for Tamiami Trail based on the Pinellas County study are shown in Table 2. A summary of the predicted contaminant concentrations from both studies is presented in Table 3.

Discussion of Results

The results of the analysis indicate that there will be no significant impact on the quality of the water in the vicinity of Tamiami Trail (Table 4).

It should be noted that Class III Fresh Water Criteria for some pollutants varies from one location to the other, as they are dependant on hardness. For any given metal (e.g. Cadmium, Chromium (trivalent), Copper, Lead, Nickel, and Zinc), Florida Administrative Code (FAC) provides a mathematical formula to calculate the criterion as a function of water hardness. Consequently, as the hardness changes, the criteria change accordingly.

Hardness also does change over time depending on many factors. One of the most influencing factors is water pH. As the pH decreases, water become more acidic and the concentration of hardness decreases and vice versa. Any environmental factor that affects the pH will have an impact on the water hardness.

The water environment in wetlands is generally, acidic. During the wet season, rainwater often increases the water pH, bringing it to neutral or slightly basic condition resulting in an increase in the concentrations of hardness. This concept may explain the higher hardness values during the summer (wet season). To follow the FAC equations for calculating the criteria for different metals at different sampling stations, the average hardness values measured over the sampling period (more than 20 years at some locations) at each sampling station were used.

Class III Criterion for cadmium ranges from 1.20 μg/l at Station S355A to 2.20 μg/l at Station S333DS. Existing concentrations of cadmium along Tamiami Trail range from 0.10 to 1.14 μg/l. Maximum predicted concentrations (maximum values of the concentrations predicted using the two studies: I-275 and Bayside Bridge) of the of cadmium are 0.06 μg/l in year 2000 and 0.11 μg/l in year 2020. Minimum predicted concentrations (minimum values of the concentrations predicted using the two studies: I-275 and Bayside Bridge) are 0.04 μg/l and 0.06 μg/l in year 2000 and 2020, respectively. The conclusion of this comparison shows that there will be no predictable impact from cadmium on the neighboring water body. Similar conclusions may be drawn for chromium, and nickel.

Total suspended solids, total solids and manganese are not regulated under *Florida Administrative Code Chapter: 62-302.530, Criteria for Surface Water Quality Classifications*. However, the predicted levels were calculated and documented for future reference.

For oil and grease, the predicted concentrations of 215.07 μg/l in year 2000 and 380.51 μg/l in year 2020 are much lower than the Class III Criteria of 5,000.00 μg/l. There are no records of the existing oil and grease concentrations at the sampling stations.

The analysis also predicts that there will be no significant impact from the primary polluting metals (copper, lead, and zinc) in the stormwater runoff. Predicted results from this study are consistent with the results reported by Driscoll et. al. (1990) for highways with less than 30,000 VPD. (Copper: 0.022 mg/l, Lead: 0.08 mg/l, Zinc: 0.08 mg/l).

Class III Criterion for copper ranges from 12.20 μg/l at Station S355A to 24.00 μg/l at Station S333DS. Existing concentrations of copper along Tamiami Trail range from 1.00 to 6.60 μg/l. Maximum predicted concentrations of copper are 1.48 μg/l in year 2000 and 2.62 μg/l in year 2020. Minimum predicted concentrations are 0.92 μg/l and 1.63 μg/l in year 2000 and 2020, respectively.

For iron, Class III Criterion is 1000 μg/l. Existing concentrations along Tamiami Trail range from 17.3 to 994 μg/l. Maximum predicted concentrations (in the runoff) of iron are 98.17 μg/l in year 2000 and 173.69 μg/l in year 2020. Minimum predicted concentrations are 30.49 μg/l and 53.95 μg/l in year 2000 and 2020, respectively.

For lead, Class III Criterion ranges from 3.30 μg/l at Station S355A to 9.10 μg/l at Station S333DS. Existing concentrations along Tamiami Trail ranged from 0.50 to 18.08 μg/l. Maximum predicted concentrations of lead are 2.51 μg/l in year 2000 and 4.43 μg/l in year 2020. Minimum predicted concentrations are 0.83 μg/l and 1.47 μg/l in year 2000 and 2020, respectively. It was noted that a single violation of Class III Fresh Water Criteria at Station S12D occurred in July 1992, where the existing lead concentration was 18.08 μg/l higher than the criterion (7.70 μg/l). The previous lead concentration measured at this station was 1.17 μg/l in June 1992, and the following measurement was 1.98 μg/l in September 1992. The next highest value recorded at this station was 2.65 μg/l, suggesting that the 18.08 μg/l record was a single incident or possibly an incorrect data notation in the record.

Class III Criterion for zinc ranges from 109.60 μg/l at station S355A to 213.90 μg/l at station S333DS. Existing concentrations of zinc along Tamiami Trail range from 4.00 to 329.01 μg/l. Maximum predicted concentrations of zinc are 10.02 μg/l in year 2000 and 17.73 μg/l in year 2020. Minimum predicted concentrations are 8.96 μg/l and 15.85 μg/l in year 2000 and 2020, respectively.

Predicted concentrations for some contaminants (e.g. zinc), although they did not violate Class III Fresh Water Criteria under any condition, can be found to be slightly higher than the existing minimum concentrations but well below the existing maximum concentrations. These observations are based on the data obtained from SFWMD and the results of the Howard Frankland Bridge and the Bayside Bridge studies. A detailed sampling and monitoring program for the Tamiami Trail is suggested to confirm these conclusions.

Biological Aspects

In general, highway runoff contains pollutants: that have a potential to adversely affect species dependent on wetland habitat for all or part of their life cycles; that can lead to the pollution of wetlands; and, that can cause a decline of wetlands values (Clairmont Graduate University and Rails-to-Trails Conservancy, 1998). However, documentation of adverse effects of highway runoff on aquatic organisms and their communities does not provide a clear relationship. Smith and Kaster (1983) reported that along a rural highway with relatively low vehicle counts (7,000 – 8,000 VPD) disruptions of benthic macroinvertebrate communities were negligible. However, other biological studies have documented changes in individual organisms and community structures at sites with low traffic volumes (Buckler and Granato, 1999). Generally, the ecological effects of highway runoff quality on receiving waters have been predicted using statistical models of contaminant concentrations and loadings. These predictive models indicate that there should be no measurable water quality effects at sites with annual daily traffic volumes supporting less than 30,000 VPD, (Driscoll et al., 1990).

Summary of Findings

This report has been prepared to investigate the impact of storm water runoff from Tamiami Trail on the adjacent water body. Predicted pollutant concentrations from the Trail were compared to a) existing pollutant concentrations from 10 sampling stations along the Trail and b) Class III Fresh Water Criteria. A brief literature review of stormwater runoff impact on the biological aspects of the neighboring aquatic environment was also conducted.

The data considered for the analysis were selected to be the most current (recent) data of metal concentrations and were gathered from locations having similar climatic and geographical characteristics.

The results of the investigation predicts/confirms that pollutant levels in stormwater runoff from the Tamiami Trail, for an average daily traffic of 5,200 VPD in 2000, and 9,200 VPD in 2020, will have little effect on the quality of the water and the surrounding aquatic habitat in the Tamiami Canal. The predicted concentrations are expected to be less than the contaminant concentrations delivered to the site from other locations by the network of canals. Therefore, this paper suggests that there is no immediate, water quality driven need to provide stormwater treatment facility. This conclusion is reached after comparing the predicted pollutant concentrations in the storm water runoff from the Trail based on both year 2000 and 2020 traffic volumes to a) Class III Fresh Water Criteria; and b) existing pollutant concentrations in the ambient waters adjacent to the Trail.

In summary, Tamiami Trail is a unique project since it is located between two classes of water bodies: Class III Fresh Water to the north and Class III Outstanding Florida Water to the South where no water quality degradation is allowed. Future increase in traffic may contribute to further minimal degradations generated from the past or current operations of the roadway. In the same future time period, technology advances in the automotive industry are expected to further reduce the amount of contaminants (e.g. lead) released from roadways to the environment, as documented in the last 10 years or so in this report. Lastly, it would not appear prudent to provide stormwater treatment for existing conditions which do not violate standards or future conditions which predictably meet standards, at the expense of measurable, physical impacts to wildlife and wetlands supported and protected by National Park covenants. Furthermore, the construction of stormwater treatment facilities would result in additional turbidity, the release of extant nutrients, and contribute to instability in vegetation and soils.

Finally, the conclusions identified in this report could be evaluated and confirmed by designing and conducting a detailed sampling and monitoring program for the project area under normal operating conditions.

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Table 1: Predicted Contaminant Levels for Tamiami Trail Based on I-275, Tampa, Florida Study (1996).
(Concentrations are in milligrams per liter.) - DRAFT

mg/l	Medians of 5 sampling locations (103000 VPD)	Prorated Values for Tamiami Trail (5200 VPD)	Prorated Values for Tamiami Trail (9200 VPD)
Cadmium	0.001	0.000	0.000
Chromium	0.015	0.001	0.001
Copper	0.018	0.001	0.002
Iron	0.604	0.030	0.054
Lead	0.017	0.001	0.001
Manganese	0.036	0.002	0.003
Nickel	0.007	0.000	0.001
Oil&Grease	4.260	0.215	0.381
TS	308.000	15.550	27.511
TSS	50.500	2.550	4.511
Zinc	0.178	0.009	0.016

Source: HDR, 1996

Table 2: Predicted Contaminant Levels for Tamiami Trail Based on Pinellas County Study (1996).
(Concentrations are in milligrams per liter.)

mg/l	Mean Values (43593 VPD)	Prorated Values for Tamiami Trail (5200 VPD)	Prorated Values for Tamiami Trail (9200 VPD)
Cadmium	0.000	0.000	0.000
Chromium	0.004	0.001	0.001
Copper	0.012	0.001	0.003
Iron	0.823	0.098	0.174
Lead	0.021	0.003	0.004
Nickel	0.004	0.000	0.001
TSS	20.000	2.386	4.221
Zinc	0.084	0.010	0.018

Source: Stoker, 1996

Table 3: Expected Pollutant Concentrations for Tamiami Trail Based on Previous Studies Performed in Florida in 1996.
(Concentrations are in micrograms per liter.)

	I-275 Study		Pinellas Study	
	Tamiami (5200 VPD)	Tamiami (9200 VPD)	Tamiami (5200 VPD)	Tamiami (9200 VPD)
Cadmium	0.062	0.110	0.035	0.061
Chromium	0.732	1.295	0.513	0.907
Copper	0.919	1.626	1.479	2.617
Iron	30.493	53.950	98.172	173.688
Lead	0.833	1.474	2.505	4.432
Manganese	1.797	3.180	N/A	N/A
Nickel	0.334	0.590	0.477	0.844
Oil&Grease	215.068	380.505	N/A	N/A
TS	15549.515	27510.680	N/A	N/A
TSS	2549.515	4510.680	2385.704	4220.861
Zinc	8.961	15.854	10.020	17.728

N/A : Data were not available.

Table 4: Comparison of Existing Pollutant Concentrations, Class III Fresh Water Criteria, and Predicted Concentrations from Tamiami Trail Runoff Based on a) I-275 Study, and b) Pinellas County Study.

		Station	1	2	3	4	5	6	7	8	9	10
		Code	**S12D**	**S333**	**S12E**	**S333DS**	**Frogcity**	**S355A**	**G69**	**TAMBR6**	**S355B**	**S334**
Cadmium	Existing		0.1-1.59	0.1-1.14	0.30	0.23-0.622	0.3-0.76	0.30	N/A	0.3-0.44	0.3-0.37	0.3-0.39
	Class III Criteria		2.00	2.00	1.80	2.20	1.80	1.20	1.60	1.90	1.60	1.90
	Predicted	I-275	0.06 - 0.11									
		Pinellas	0.04 - 0.06									
Chromium	Existing		1.03	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Class III Criteria		11.00									
	Predicted	I-275	0.73 - 1.30									
		Pinellas	0.51 - 0.91									
Copper	Existing		1-4.37	1-6.6	1.20	4.06-5.54	1.2-1.37	1.2-1.6	N/A	1.2-1.6	1.20	1.2-1.46
	Class III Criteria		21.40	22.30	20.10	24.00	20.10	12.20	17.70	20.40	16.80	20.60
	Predicted	I-275	0.92 - 1.63									
		Pinellas	1.48 - 2.62									
Iron	Existing		0.04-0.83	0.06-0.65	N/A	0.15	N/A	N/A	N/A	N/A	N/A	N/A
	Class III Criteria		1000.00									
	Predicted	I-275	30.49 - 53.95									
		Pinellas	98.17 - 173.69									
Lead	Existing		0.5-18.08	0.5-4.03	0.80	0.8-0.96	0.8-1.68	N/A	N/A	0.80	N/A	N/A
	Class III Criteria		7.70	8.20	7.00	9.10	7.00	3.30	5.80	7.20	5.40	7.30
	Predicted	I-275	0.83 - 1.47									
		Pinellas	2.51 - 4.43									
Manganese	Class III Criteria		None									
	Predicted	I-275	1.80 - 3.18									
		Pinellas	N/A									
Nickel	Existing		6.11	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Class III Criteria		283.40	295.30	266.50	317.80	266.50	163.00	234.70	270.20	223.40	272.60
	Predicted	I-275	0.33 - 0.59									
		Pinellas	0.48 -0.84									
Oil&Grease	Class III Criteria		5000.00									
	Predicted	I-275	215.07 - 380.51									
		Pinellas	N/A									
Total Solids	Class III Criteria		None									
	Predicted	I-275	15549.52 - 27510.68									
		Pinellas	N/A									
Total Suspended Solids	Class III Criteria		None									
	Predicted	I-275	2549.52 - 4510.68									
		Pinellas	2385.70 - 4220.86									
Zinc	Existing		4-250.61	4-329.01	4.00	18-20	4-22.62	4-4.53	N/A	4-14.74	4.00	4.00
	Class III Criteria		190.70	198.70	179.30	213.90	179.30	109.60	157.80	181.80	150.30	183.40
	Predicted	I-275	8.96 - 15.85									
		Pinellas	10.02 - 17.73									

N/A : Data were not available.

1. Data analyzed are for the 1990's except for Nickel and Chromium as the most recent data for these two metals are from the 1980's.
2. Criteria reported for the chromium are those of hexavalent (trivalent concentrations have higher limits).
3. All concentrations reported are in micrograms/L (μg/l).
4. Cadmium predicted concentrations for Tamiami Trail based on I-275 study are 0.06 μg/l for 5200 VPD and 0.11 μg/l for 9200 VPD.